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Continuous information displays for multiple patient monitoring

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Patient alarms occur frequently in hospitals, but they often do not require clinical intervention. As a result, clinicians can become desensitized to alarms and may fail to respond to them, including to alarms that are clinically relevant. Clinicians and researchers have investigated ways to make alarms more informative by adding delays (Gorges, Markewitz, & Westenskow, 2009) and developing 'smart' alarm systems (Imhoff, Kuhls, Gather, & Fried, 2009), but no approach has been universally accepted (for a review see Graham & Cvach, 2010).

We are investigating the potential for head-worn displays (HWDs) to help mobile clinicians remotely monitor multiple patients while they perform other clinical tasks. We developed a computerized, multiple-patient monitoring microworld, and designed an initial study to test the efficacy of continuous displays for patient monitoring when added to conventional alarms.

Specifically, the study tested whether continuous patient information, displayed on a conventional monitor, reduces patient waiting time for treatment and helps participants prioritize clinically relevant alarms over clinically irrelevant alarms. Clinically relevant alarms occurred when numerical values for heart rate, blood pressure or oxygen saturation becoming too high or too low. Clinically irrelevant alarms took the form of impossibly high or low values for any of the three vital signs, representing a signal failure. Participants navigated between patient rooms in the microworld using the keyboard and they responded to patient alarms using mouse clicks.

The data showed that the total accumulated time in the 30-minute scenario that patients with a clinically relevant alarm were left waiting was significantly shorter in the alarms plus monitor condition ($M = 11.6$ min, $SD = 4.0$) than in the alarms only condition ($M = 15.9$ min, $SD = 1.7$); $t(22) = 3.41$, $p = .001$; $d = 1.39$. Participants in the alarms plus monitor condition relied less on the nursing aide to treat patient alarms ($M = 6.25$ alarms, $SD = 6.70$) than did participants in the alarms only condition ($M = 11.5$ alarms, $SD = 4.36$); $t(22) = 2.27$, $p = .02$; $d = .93$.

We surmise that participants who had access to the continuous patient information could anticipate patient deteriorations and could distinguish clinically relevant versus irrelevant alarms without having to move to the patient's bedside. Note that the difference between conditions was found without requiring participants to perform a secondary task.

Although the present study is highly simplified, it demonstrates that situations can be set up in the microworld that show the advantage of having a continuous display of patient vital signs. We are currently testing whether the above results hold when continuous patient information is presented on a HWD and the participant is distracted by an ongoing task. Outcomes of the program of research will help determine whether or not head-worn displays could help clinicians monitor the status of multiple patients, while also potentially improving their ability to carry out other clinical tasks.

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